New York University Tandon School of Engineering
Department of Computer Science & Engineering

CS6923 Spring 2025
Introduction to Machine Learning Professor Sandoval

Contact`
Email: gustavo.sandoval@nyu.edu
My background is here.

Student hours:

- Zoom: nyu.zoom.us/my/Sandoval
- Office hours: Wed: 2 – 3. – Please email if you are coming as sometimes I have conflicts—
- We will post all Office hours in Gradescope.

Student Assistants:

1. Amardeep Kumar - ak11089@nyu.edu
2. Soumili Nandi - ak11089@nyu.edu
3. Sakshi Goenka - sg8156@nyu.edu

Course Pre-requisites

Modern machine learning uses a lot of math! Probably more than any other subject in computer science outside theoretical computer science. You can get pretty far with an understanding of calculus, probability, and linear algebra, but *that understanding must be solid* to succeed in this course.

Here are the topics you should know from:

- **Probability:** Random variables, discrete and continuous probability distributions, expectation, variance, covariance, correlation, conditional and joint probability, Gaussian random variables, law of large numbers. Formally, we require a prior course in probability or statistics. If you need to freshen up on linear algebra, this quick reference from Stanford is helpful.

- **Linear Algebra:** Matrices and vectors, vector inner and outer products, matrix-vector and matrix-matrix multiplication, vector norms (e.g. Euclidean), matrix norms (e.g., Frobenious, operator), triangle inequality, solving systems of linear equations, linear independence, matrix rank, null space, orthogonal matrices, basics of eigenvectors, eigenvalues, and eigendecomposition.

You also need to be a good programmer for this course. All coding exercises and assignments will be in Python. No prior experience in Python is specifically required, but I will not be focused on teaching the language besides using specific tools for machine learning. So, if you are not familiar with the basics, you will need to spend time familiarizing yourself. See the TAs if you run into any issues.

Campuswire

This term we will be using CampusWire for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on campuswire. Here's the link for our class: https://campuswire.com/p/GC62DC669 Then the key is 1479.

Python and Jupyter Notebooks

Demos and labs in this class use Python, run through Jupyter notebooks. Jupyter lets you create and edit documents with live Python code and rich comments and images. We suggest that students run their Jupyter notebooks via Google Colaboratory, and we will share them via Colab. Make sure that you use your NYU email when using the notebooks or you won't be able to acess.

Course Description

This course serves as an introduction to a **variety** of machine learning topics both from a **theoretical** and **applied** perspective.

- ***Variety***: We will introduce diverse machine learning methods for solving real-world problems.
- ***Theory***: For every method we study, we will emphasize understanding its fundamental properties: correctness, computational efficiency, potential ways to improve it, etc.
- ***Applications***: We will illustrate the efficacy of machine learning methods in how they impact applications related to specific domains, emphasizing applications from electrical and computer engineering.

Readings

There is no textbook to purchase, but the following are great references.

- James, Witten, Hastie and Tibhsirani. **An Introduction to Statistical Learning with Applications in Python**. An Introduction to Statistical Learning (statlearning.com)
- Ethem Alpaydin. **Introduction to Machine Learning** Fourth Edition. Published by MIT Press

Course requirements

- We will not take attendance, but I recommend you come to class and it will make things easier to understand.
- I will measure your **participation** with polls after class. You need to fill out 80% of them to achieve full credit.

Course Objectives

1. Students will learn how to view and formulate real-world problems in the language of machine learning. Categories of issues include those involving prediction, classification, pattern recognition, and decision-making.
2. Students will gain experience applying the most popular and most successful machine learning algorithms to example problems through in-class demonstrations and at-home programming labs. The goal is to prepare students to use these tools in industrial or academic positions.
3. In addition to experimental exploration, students will learn how theoretical analysis can help explain the performance of machine learning algorithms and ultimately guide how they are used in practice or lead to the design of entirely new methods.
4. Students will build experience with the most important mathematical tools used in machine learning, including probability, statistics, and linear algebra. This experience will prepare them for more advanced coursework or research.
5. A primary goal is to prepare students to read and understand contemporary research in machine learning, including papers from NeurIPS, ICML, ICLR, AAAI, JMLR, and other major machine learning venues. Since machine learning is a rapidly evolving field, many of its most powerful tools today may no longer be relevant in 15 years. The goal is to provide students with a theoretical foundation that will allow them to keep up with changes in the field

Cooperation Policy

You will work individually on every assignment. You may discuss solutions with your classmates, but stop short of sharing your code with them.

Academic Honesty

All work submitted in this course must be your own. Cheating and plagiarism will not be tolerated. If you have any questions about a specific case, *please ask me.*

NYU Poly's Policy on Academic Misconduct: http://engineering.nyu.edu/academics/code-of-conduct/academic-misconduct

Course schedule (**Tentative**)

1. Introduction to Machine Learning
2. Simple Linear Regression
3. Multiple Linear Regression
4. Model Selection
5. Regularization
6. Logistic Regression
7. NonLinear Optimization
8. K-nearest Neighbors
9. Support Vector Machines
10. Decision Trees and Random Forest
11. Neural Networks and BackPropagation
12. Convolutional and Deep Networks
13. PCA

14. Clustering
15. ML and Security

The most up to date schedule for the class will be on Brightpsace.

<u>Course Structure and Grading:</u>

One weekly class meeting involves a lecture, demonstrations, and ungraded exercises. You will also work on assignments at home and take a midterm and a final.

Class participation (10%) This grade captures how much you contribute to your learning and your peers. This will be measured after-class polls and during-class polls.

Programming labs (15% of grade) and written problem sets (15% of grade). These assignments are completed at home and reinforce the material discussed in class. I expect **a lot of your learning to occur while working on these exercises,** and investing time on them is the best way to prepare for the exams. Assignments and their due dates will be posted on the course webpage. Late assignments will only be accepted if there are extenuating circumstances and you have obtained prior permission from the instructor.

We will have an in class Midterm (30% of grade) and Final Exam (30% of grade). For both exams, you will be allowed a cheat sheet (a two-sided piece of paper with whatever information you want on it)

<u>Letter Grades</u>

#	Symbol*	Start %*	Color	Assigned Value %
1	F	0		0
2	D	59.45		60
3	D+	66.45		67
4	C-	69.45		70
5	C	72.45		73
6	C+	76.45		77
7	B-	79.45		80
8	B	82.45		83
9	B+	86.45		87
10	A-	89.45		90
11	A	94.45		95

Other Grading notes:

Please consider the following during and after the semester and save yourself one or many emails.

1) **I must grade every student the same way.** To this end, I cannot give you special consideration as a result of your academic status (probation or otherwise), scholarships, work status, family situation, visa status, race, color, creed, religious beliefs, past alien abductions, current moon cycle, location of the sun in the sky or anything other than your academic performance. **Your grade must be based on your academic performance in my class**.
2) **I cannot change your grade simply because you asked me to.** Your grade is calculated based on your performance from the first day of class to the moment you turn in the final exam.
3) **I will not give you additional work.** Please remember that I must treat all students the same, so if I give you additional work, I will have to give it to the entire class. This is unfair to the students who complete their work on time.
4) **Your grade is a measure of your performance in my class.** If you receive an "F" it is because you have demonstrated that you do not understand the material in the course; if you receive an "A" it is because you have demonstrated that you fully understand the material covered in the course. Other grades are assigned accordingly.

Moses Center Statement of Disability

If you are student with a disability who is requesting accommodations, please contact New York University's Moses Center for Students with Disabilities (CSD) at 212-998-4980 or mosescsd@nyu.edu. You must be registered with CSD to receive accommodations. Information about the Moses Center can be found at www.nyu.edu/csd. The Moses Center is located at 726 Broadway on the 3rd floor.

Academic Honesty

NYU School of Engineering Policies and Procedures on Academic Misconduct – complete Student Code of Conduct here

A. **Introduction**: The School of Engineering encourages academic excellence in an environment that promotes honesty, integrity, and fairness, and students at the School of Engineering are expected to exhibit those qualities in their academic work. Through the process of submitting their own work and receiving honest feedback on that work, students may progress academically. Any act of academic dishonesty is seen as an attack upon the School and will not be tolerated. Furthermore, those who breach the School's rules on academic integrity will be sanctioned under this Policy. Students are responsible for familiarizing themselves with the School's Policy on Academic Misconduct.

B. **Definition**: Academic dishonesty may include misrepresentation, deception, dishonesty, or any act of falsification committed by a student to influence a grade or other academic evaluation. Academic dishonesty also includes intentionally damaging the academic work of others or assisting other students in acts of dishonesty. Common examples of academically dishonest behavior include, but are not limited to, the following:

1. **Cheating**: intentionally using or attempting to use unauthorized notes, books, electronic media, or electronic communications in an exam; talking with fellow students or looking at another person's work during an exam; submitting work prepared in advance for an in-class examination; having someone take an exam for you or taking an exam for someone else; violating other rules governing the administration of examinations.
2. **Fabrication**: including but not limited to, falsifying experimental data and/or citations.
3. **Plagiarism**: Intentionally or knowingly representing the words or ideas of another as one's own in any academic exercise; failure to attribute direct quotations, paraphrases, or borrowed facts or information.
4. **Unauthorized collaboration**: working together on work meant to be done individually.
5. **Duplicating work**: presenting for grading the same work for more than one project or in more than one class, unless express and prior permission has been received from the course instructor(s) or research adviser involved.
6. **Forgery**: altering any academic document, including, but not limited to, academic records, admissions materials, or medical excuses.

NYU School of Engineering Policies and Procedures on Excused Absences – complete policy here

A. Introduction: An absence can be excused if you have missed no more than **10 days of school**. If an illness or special circumstance has caused you to miss more than two weeks of school, please refer to the section labeled Medical Leave of Absence.

B. Students may request special accommodations for an absence to be excused in the following cases:
1. Medical reasons
2. Death in immediate family
3. Personal qualified emergencies (documentation must be provided)
4. Religious Expression or Practice

Deanna Rayment, deanna.rayment@nyu.edu, is the *Coordinator of Student Advocacy, Compliance and Student Affairs* and handles excused absences. She is located in 5 MTC, LC240C and can assist you should it become necessary.

NYU School of Engineering Academic Calendar – complete list here.

Please pay attention to notable dates such as Add/Drop, Withdrawal, etc. For confirmation of dates or further information, please contact Susana: sgarcia@nyu.edu